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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
The Portals
445 Twelfth Street, S.W.
Washington, DC 20554

Re: ***Notice of Ex Parte Presentation***:
IB Docket No. 01-185

Dear Mr. Caton:

On February 21, 2002, Alan Auckenthaler, General Counsel of Inmarsat Ventures plc, Don Kennedy, Director, International Regulatory Affairs of Inmarsat Ltd., Jonas Eneberg, Inmarsat Ltd., Giselle Creeser and Dr. Richard J. Barnett of Telecomm Strategies L.L.C., and the undersigned, met with Trey Hanbury, Paul Locke and Sankur Persaud of the International Bureau. The topics of discussion were those described in the enclosed set of presentation materials and the Inmarsat positions of record in this proceeding.

An original and one copy are enclosed.

Respectfully submitted,

John P. Janka

Enclosure

cc:
(w/out enclosure)
Trey Hanbury
Paul Locke
Sankar Persaud

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Presentation to The Federal Communications Commission

Inmarsat Ventures PLC

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Purpose of Meeting

- Summarize Inmarsat's position on ATC
- Explain Inmarsat's technical analysis of ATC interference in the L band
- Respond to recent MSV ex parte presentations

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Overview

- ATC operations are not feasible at L band because of heavy use by incumbent satellite systems
- ATC fundamentally alters the interference environment in which Inmarsat designed its multi-billion dollar satellite network to operate
- ATC operations would cause far more interference to Inmarsat than created by MSV's satellite-only operations
- ATC mobile stations transmitting in the uplink L band anywhere in the US would interfere with Inmarsat satellite receivers, harming safety, aeronautical, maritime and land mobile services alike
- ATC base stations transmitting in the downlink L band would desensitize/overload nearby Inmarsat aeronautical, maritime and land mobile receivers
- Self-interference into MSV from ATC will increase MSV's need for L band spectrum

Overview (cont'd)

- MSV's & Inmarsat's new satellite systems improve prospects for satellite coordination and increase satellite spectrum sharing capabilities
  - However, addition of ATC in the L band would
    - significantly reduce coordination flexibility
    - curtail use of future advances in MSS satellite technology
- ATC in the L band would violate the Mexico City MOU and is not supported by the ITU Table of Frequency Allocations
- ITU-R studies show terrestrial/satellite sharing is not feasible in MSS bands
  - IMT-2000 assumes separate bands for satellite and terrestrial components (Rec. M.1036)

Summary of Inmarsat System

- 9 GSO spacecraft in orbit using the L band
- Over 220,000 earth terminals registered for use
- Annual revenues of over $400,000,000
- $1.72 billion being invested in Inmarsat 4 system, launching in 2003
- System heavily used by
  - US Navy, Coast Guard and FAA
  - Commercial airlines, cargo ships and passenger ships
  - Humanitarian aid and media organizations
- Land mobile service in US possible only since October 2001

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Why the L Band Is Different

- L band is heavily used around the world by satellite networks
  - For this reason, the US entered into the Mexico City MOU
- The entire L band is shared on a co-channel basis in different geographic areas
  - Terrestrial use of L band in US therefore can cause co-channel interference to an MSS system operating outside the US
- Dynamic spectrum reassignments
  - Under Mexico City MOU, L band frequencies are to be reassigned annually among MSS systems, based on projected demand for service on each system
- No basis for allowing one MSS system to use "extra" L band spectrum for terrestrial service instead
- Terrestrial use violates the Mexico City MOU

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Status of Inmarsat/MSV Satellite Spectrum Sharing

- All L band spectrum is shared co-channel between MSS service providers in different geographic areas, with assignments subject to change annually
  - 13 of the 17 beams on Inmarsat-3 satellites visible from the US can share spectrum with one or more MSV beams

- MSV has access to spectrum that it is not using for MSS service
  - Mexico City MOU provides for MSV to release that spectrum to other MSS operators
  - Inmarsat needs more spectrum
  - There is no basis for MSV to preserve unused L band spectrum for ATC

- UK has sent a letter to the US addressing MSV's failure to coordinate under Mexico City

- Inmarsat stands ready to resume annual coordination

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Status of Inmarsat/MSV Satellite Spectrum Sharing

- Improved satellite technology supports increased spectrum reuse for MSS
  - Inmarsat next generation changes
    - Spot Beams - Inmarsat-4 beams have much narrower beam-widths than Inmarsat-3 beams
    - No feeder link constraint – Inmarsat-3 satellites have feeder link constraint that precludes use of 4 MHz of L-band. Inmarsat-4 satellites will not.
  - MSV next generation changes
    - MSV acknowledges that interference to other MSS satellites will be reduced by next-generation MSV satellite design
    - Spot beam technology
    - Reduction of MSV uplink terminal EIRP spectral density
- Spectrum can be reused with smaller geographic separation between reuses if operators accept existing levels of interference
    - Increases efficient use of spectrum
- ATC would substantially curtail satellite reuse of spectrum

Interference Scenarios

- Uplink Band:
  - MSV ATC terminals
    - Interference to both Inmarsat and MSV spacecraft
      - Co-channel interference to MSS satellite receivers
      - Adjacent channel interference to MSS satellite receivers
- Downlink Band:
  - MSV ATC base stations
    - Interference to Inmarsat mobile receivers
      - Overload
      - Out of Band Emissions
- Interference both within and outside the US

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Uplink Interference Summary

- MSV co-channel terrestrial ATC carriers would interfere with Inmarsat satellite beams covering areas outside the U.S.
  - One carrier could create approx 0.7% increase in the Inmarsat satellite noise temperature
  - Fewer than fourteen carriers would create an aggregate 6% noise temperature increase
  - Realistic to expect many more simultaneous co-channel ATC carriers, which would significantly degrade the Inmarsat system
    - Inmarsat's analysis shows that MSV's assumed 2,000 co-channel carriers leads to $\Delta T/T$ levels of 425%
    - No technical limit on the number of ATC base stations that could be deployed
- Out-of-band emissions from MSV ATC carriers also would interfere with Inmarsat beams covering the US

Uplink Interference: MSV ATC terminals into Inmarsat Satellite Receivers

- Inmarsat and MSV methodology for calculating interference is similar
- Number of key parameters where Inmarsat and MSV disagree on appropriate value:
  - Shielding
  - Vo-coder
  - Power control, polarization isolation, voice activity
- Different assumptions result in as much as a 21-26 dB disparity between the interference analyses

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Uplink Interference---Shielding Factor

- Shielding --- Delta between assumed values 7 to 12 dB
  - Inmarsat has provided measured data that shows that 50% of the time the shielding in urban areas is 3 dB or less
  - Motient assumes 15 dB or 10 dB of shielding
- Misapplication of propagation models
  - Models created to design a wanted link are irrelevant when using shielding to try to avoid interference with another system
  - Hess Model inapplicable because it predicts fade levels for probabilities of 50% to 99% of the time

Uplink Interference---Shielding Factor

- Identifying fade levels that occur <50% of the time is critical
  - Inmarsat is most susceptible to receiving interference in those cases

- *Measured data* shows average attenuation is 1.9 dB
  - Represents "average shielding" --- fades encountered by the entire population of users averaged over the coverage area.

- Average fade is close to the median value (50%)
  - 1 of every 2 ATC signals would be attenuated by 3 db or less
  - 1 of every 3 ATC signals would be attenuated by 0 dB or less

- Unreasonable to assume that ATC transmitters will mostly operate inside buildings
  - Many PCS/cell phones do not operate well inside many office buildings

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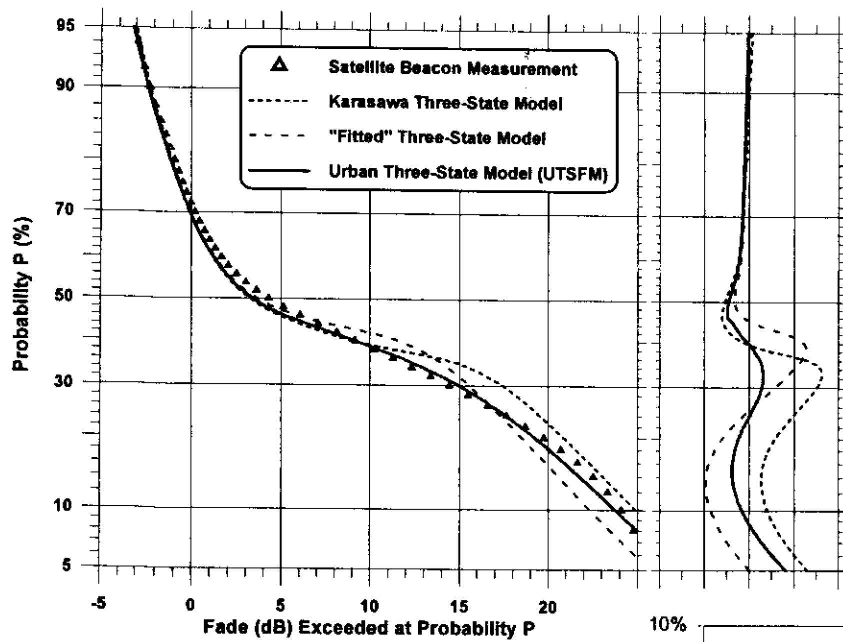
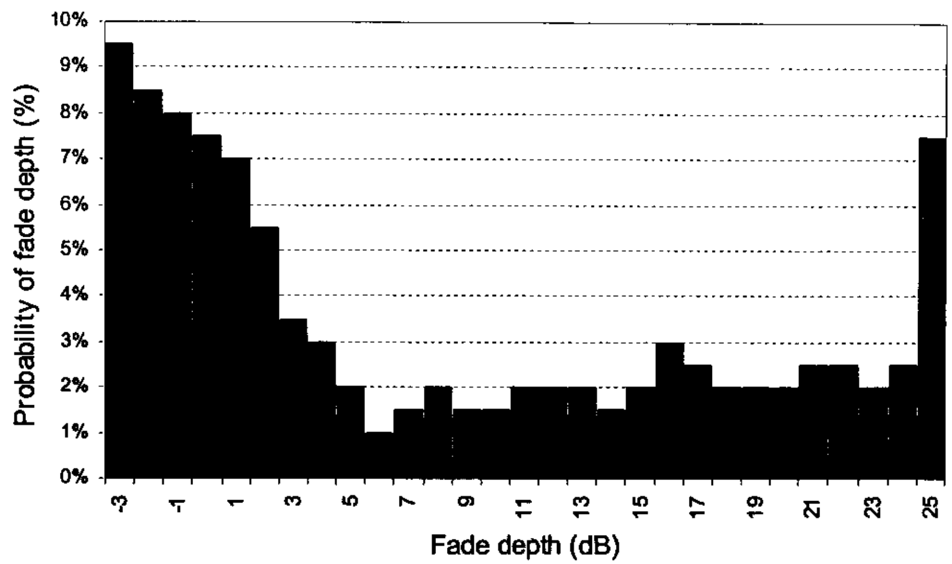
Uplink Interference-Measured Propagation Data





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Uplink Interference—Vo-coder Factor

- Vo-coder Factor --- Delta between assumptions is 7.4 dB
  - Newly introduced in MSV's Jan 2002 ex-parte presentations
  - Provides 7.4 dB advantage for MSV
    - Perhaps used to compensate for the lower shielding value MSV now uses
  - Any reliance on this parameter would be misplaced
    - Vo-coders increase the number of users/carrier, and decrease the power of each user but the overall carrier power remains the same
      - Vo-coders degrade the quality of service to users, so it is not logical to use them solely to reduce power of individual users
    - 7.4 dB is the power reduction for a terminal using ¼ rate vo-coder, not the average power reduction in a population of terminals using different vo-coders (MSV claims average reduction of 7.4 dB)
    - No guarantee that this technology would even be employed for ATC voice circuits
  - Vo-coders not used for data traffic

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Uplink Interference---Other Factors

- Power Control Advantage, Polarization Isolation and Voice Activity --- Delta between assumed values 6.6 dB
  - MSV assumes values applicable only with a very large number of deployed terrestrial transmitters
  - Inmarsat's analysis demonstrates that a very small number of terrestrial transmitters will cause MSS satellite receivers significant interference
  - Therefore wrong to rely on values assumed by MSV

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Uplink Interference---Other Factors

- MSS Receive Satellite Antenna Discrimination
  - MSV usually assumes 30 dB, but has also used 20 and 25 dB
  - Inmarsat currently operates co-frequency with MSV with 22 dB isolation
  - Antenna discrimination is a key parameter used in frequency coordination between satellite networks to increase spectrum re-use between spacecraft
  - Introduction of new satellite technology would lead to more efficient use by MSS systems (greater satellite-satellite sharing)
  - Motient appears to use antenna discrimination to justify use of the L band by a non-allocated terrestrial service

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Analysis: Uplink interference from MSV ATC Terminals into Inmarsat

- Following Table provides deltaT/T analysis from MSV into Inmarsat
  - Column 1: MSV interference analysis from satellite terminals contained in 11 Jan 02 ex-parte.
  - Column 2: Inmarsat interference analysis from satellite terminals. *Only difference is reuse factor. MSV uses 28 based on 7-cell reuse/200 beams. Inmarsat estimates an optimistic reuse factor for a fully loaded MSV satellite is 10*
  - Column 3: MSV interference analysis from terrestrial terminals contained in 11 Jan 02 ex-parte
  - Column 4: Inmarsat interference analysis from terrestrial terminals. *Differences in the key parameters addressed earlier*
- 21 dB difference between the Inmarsat and MSV terrestrial interference analyses (using MSV's latest values)

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Analysis: Uplink Co-channel Interference from MSV Satellite & ATC Stations into Inmarsat Satellites

		MSV-S interference		MSV-T interference	
		MSV	Inmarsat	MSV	Inmarsat
Inmarsat-4 satellite antenna gain	dBi	41	41	41	41
Inmarsat-4 satellite receiver noise temperature	K	650	650	650	650
Inmarsat-4 satellite receiver noise spectral density	dBW/Hz	-200.5	-200.5	-200.5	-200.5
Inmarsat-4 satellite G/T	dB/K	12.9	12.9	12.9	12.9
Maximum MSV satellite terminal EIRP	dBW	5.0	5.0	-	-
MSV satellite carrier bandwidth	kHz	50.0	50.0	-	-
MSV satellite terminal EIRP spectral density	dBW/Hz	-42.0	-42.0	-	-
MSV terrestrial mobile EIRP	dBW	-	-	0	0
MSV terrestrial carrier bandwidth	kHz	-	-	200	200
MSV terrestrial mobile EIRP spectral density	dBW/Hz	-	-	-53.0	-53.0
Free space loss	dB	188.8	188.8	188.8	188.8
Average shielding	dB	0	0	10	3
Average Inmarsat-4 satellite receive antenna discrimination	dB	20	20	20	20
Power control advantage	dB	2	2	6	2
Variable-rate vocoder advantage	dB	0	0	7.4	0
Polarization isolation	dB	0	0	3	1.4
Voice activity factor	dB	3	3	1	0
Received interfering signal spectrum density per carrier	dBW/Hz	-214.8	-214.8	-248.2	-227.2
Delta-T/T for one carrier	-	3.70%	3.70%	0.0017%	0.212%
Reuse factor	-	28	10	2000	2000
Total delta-T/T	-	**104%**	**37%**	**3%**	**424%**

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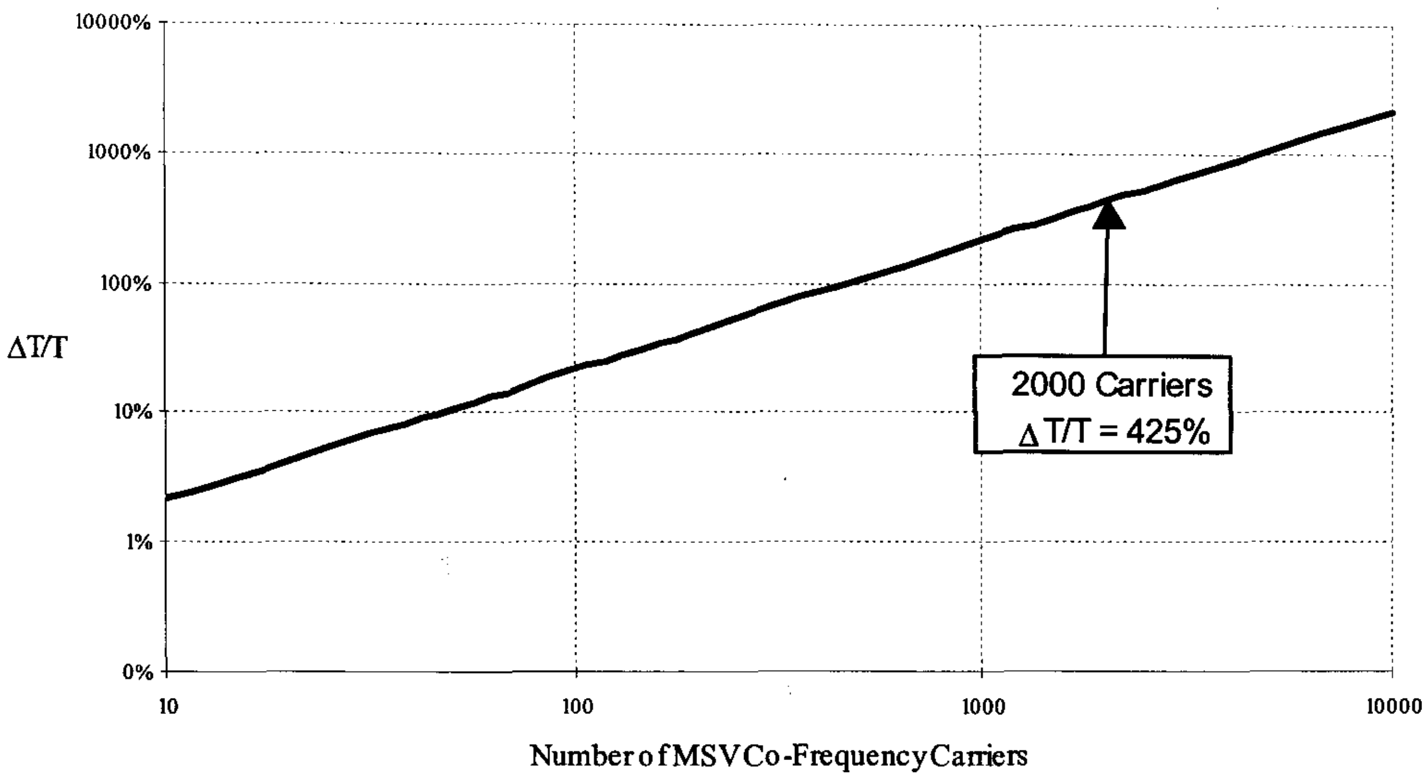
Increase in Inmarsat Satellite Noise Temperature as Function of Number of MSV ATC Carriers



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Analysis: Self-Interference Uplink Co-channel Interference from MSV ATC Stations into MSV Satellite

- Following Table provides deltaT/T analysis from MSV ATC stations into MSV satellite
  - Column 1: MSV interference analysis from ATC terminals into MSV satellite contained in 11 Jan 02 ex-parte
  - Column 2: Inmarsat interference analysis from ATC terminals into MSV satellite
- 21 dB difference between the Inmarsat and MSV terrestrial interference analyses

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Analysis: Self-Interference
Uplink Co-channel Interference from MSV ATC Stations into MSV Satellite

		MSV	Inmarsat
Link margin degradation	dB	0.25	0.25
MSV satellite antenna gain (average per beam)	dBi	41	41
MSV satellite receiver noise temperature	K	450	450
MSV satellite receiver noise spectral density	dBW/Hz	-202.1	-202.1
MSV satellite G/T	dB/K	14.5	14.5
MSV terrestrial mobile EIRP	dBW	0	0
MSV carrier bandwidth	kHz	200	200
MSV terrestrial mobile EIRP spectral density	dBW/Hz	-53.0	-53.0
Free space loss	dB	188.8	188.8
Average shielding	dB	10	3
MSV satellite receive antenna discrimination	dB	10	10
Power control advantage	dB	6	2
Variable-rate vocoder advantage	dB	7.4	0
Polarization isolation	dB	3	1.4
Voice activity factor	dB	1	0
Received interfering signal spectrum density per carrier	dBW/Hz	-238.2	-217.2
Max number of ATC carriers		244	1.9
Delta-T/T for one carrier		**0.02%**	**3.06%**

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Conclusion: Uplink Interference from ATC Stations into Inmarsat Satellites

- MSV claims in 11 Jan 02 ex-parte that ATC operations will contribute less than 1/30th of the interference effect of the satellite operations

- Using more realistic parameter values, ATC interference contribution is over 11 times greater than that of the MSV satellite operations

- Inmarsat spacecraft would receive significantly more interference from ATC than from the satellite terminals of another MSS system

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Conclusion: Uplink Interference from ATC Stations into MSV Satellite

- MSV's intra-system interference is significant and will lead to inefficient use of L band, which harms all MSS users
  - Intra-system interference will make it necessary for MSV to segment the spectrum between satellite and terrestrial service
  - If MSV requires the coordinated amount of spectrum for its satellite service, then it will need additional spectrum for its terrestrial service

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Downlink Interference - Overload of MES Receivers from ATC Base Stations

- Inmarsat and MSV methodology for calculating interference is similar

- Key parameters where Inmarsat and MSV disagree on appropriate value:
  - Propagation Model
  - Base Station EIRP
  - Polarization Isolation
  - Base Station Antenna Discrimination
  - Power Control Advantage
  - Voice Activity
  - Interference Threshold

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Downlink Interference - Overload of MES Receivers from ATC Base Stations

- Propagation Model --- Delta between assumed values 19.5 dB
  - Inmarsat uses the line-of-sight model
    - Appropriate and realistic, considering location of base station antenna on tall buildings/towers, clear signal paths along city streets, open spaces in urban and suburban areas where ATC could be deployed
- Base Station EIRP --- Delta between assumed values 9.2 dB
  - Proposed FCC rules apply broadband PCS parameters, which allow EIRP of 32 dBW/base station and thus the use of approx 25 carriers per base station
    - This value is used in the Inmarsat analysis

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Downlink Interference - Overload of MES Receivers from ATC Base Stations

- Polarization Isolation --- Delta between assumed values 6.6 dB
  - MSV application proposes vertical linear polarization
    - MSV now seems to suggest LHCP in ex parte filing of 11 Jan 02
  - Regardless of the polarization used by ATC base stations, polarization advantage cannot be relied upon in the sidelobes of small MES antennas
- Base station antenna discrimination --- Delta between assumed values 12.5 dB
  - Not clear if MSV's antenna diagrams apply for both positive and negative elevations
    - If it applies only to positive elevations then at negative elevations the relative gain is 0 dB, and Inmarsat assumes 0 dB
    - If it applies to negative elevations, 12.5 dB is not guaranteed because base station antennas can be placed at different downtilts, and MES may operate above ground level
- Power control advantage and voice activity --- Delta between assumed values 8.0 dB
  - Inmarsat values are consistent with uplink analysis

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Downlink Interference - Overload of MES Receivers from ATC Base Stations

- Interference threshold --- Delta between assumed values 45 dB
  - Inmarsat threshold of -120 dBW is based on an aggregate incident PFD of -105 dBW/m^2 in the direction of the Inmarsat satellites and a gain of +10 dBi for the MES antenna
  - Inmarsat terminals are not designed to deal with interference from non-conforming uses of the L band
  - Inmarsat users have experienced overload of MES receivers due to terrestrial interference
  - MSV asserts it has measured the threshold to be -88 dBW, but now uses a value of -75 dBW (which provides 13 dB less protection to MSS receivers)
  - Inmarsat has no reason to believe that all receivers deployed (220,000) have a -88 dBW threshold level
    - Over 30 manufacturers have made/make some of the more than 13 different Inmarsat aero, maritime, land mobile terminals

Downlink Interference - Overload of Inmarsat Receivers from ATC Base Stations

- Following Table summarizes analyses of MSV and Inmarsat
  - Column 1: Inmarsat interference analysis from MSV base stations to satellite receivers
  - Column 2: MSV interference analysis from MSV base stations to satellite receivers

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Downlink Interference - Overload of Inmarsat Receivers From ATC Base Stations

		Inmarsat	MSV
MSV base station EIRP per 200 kHz carrier	dBW	19.1	19.1
Total bandwidth of base station transmissions per sector	MHz	5	0.6
Max. number of base station carriers per sector		25	3
Distance of Inmarsat terminal from base station	m	100	100
Propagation path loss	dB	76	95.5
Power control*	dB	2	6
Voice activation*	dB	0	4
Polarization isolation (linear-to-circular)*	dB	1.4	8
Gain of Inmarsat terminal towards base station	dBi	0	0
Base station antenna discrimination towards Inmarsat MES	dB	0	12.5
Received interfering signal power	dBW	-46.3	-102.1
Threshold for overload of MSS receivers	dBW	-120	-75
Margin	dB	-73.7	27.1
* Inmarsat values used are consistent with uplink case.			

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Other Issues Exist

- Presentation has focused on technical analysis of L band ATC
- Many other issues addressed in Inmarsat filings, e.g.
  - Not feasible for MSV to monitor Inmarsat interference at MSV spacecraft
  - Practicality of using dual-band handsets to solve MSV business problem
  - Out-of-band emissions into Inmarsat from ATC in Big LEO band
  - Greater problems with non-integrated ATC providers

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Conclusion

- L band is unique because of heavy incumbent satellite use
- ATC presents significant threat of interference into operating Inmarsat network
- Any accommodation of non-conforming ATC use in L band
  - would constrain use of the L band by the primary MSS service
  - would significantly reduce satellite coordination flexibility in the L band
  - would curtail use of future advances in MSS technology at L band

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